

REMARKS

Claims 1-7, 9 and 11-12 are now present in this application.

In view of the remarks of record and the additional remarks presented below, Applicants respectfully solicit an early and favorable action on the merits.

Issues Under 35 U.S.C. § 103(a)

Claims 1-9 and 11-12 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Stine (U.S. 5,847,252) (hereinafter Stine '252) in view of Lyman et al. (U.S. 2,135,823) (hereinafter Lyman '823). This rejection is respectfully traversed.

The Examiner asserts that Stine '252 discloses a process for producing a motor fuel component that comprises paraffins by hydrotreating an olefinic stream obtained from a process in which butanes are dimerized, wherein the olefinic stream contains C₈ through C₁₂ hydrocarbons, the hydrotreating is performed by passing the olefinic stream through a series of two reactors, each hydrotreating reactor contains a catalyst such as a noble metal on an alumina support and the reactors contain a fixed bed of catalyst. Furthermore, the Examiner asserts that "it is clear" that these reactors are trickle-bed reactors because reactants flow downward. The Examiner acknowledges that Stine '252 does not disclose that the feed is in liquid phase, that the feed contains sulfur compounds, or that the catalyst contains specified amounts of metals. Furthermore, the Examiner acknowledges that Stine '252 does not disclose the specific conditions for each reactor.

As acknowledged by the Examiner, Stine '252 fails to teach or suggest a large number of the limitations of the instant invention. Lyman '823 fails to cure these deficiencies.

Applicants respectfully submit that the Examiner has failed to establish a *prima facie* case of obviousness. To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

Stine '252 discloses a process of production of boiling range hydrocarbons by the dehydrogenation of light paraffins, the oligomerization of light olefins and the hydrogenation of the resulting oligomers. In the process according to Stine '252, the saturation is clearly carried out in gas phase because the oligomerization product obtained in said process contains predominantly C₄ products, which vaporize readily at the given conditions. In the Example of Stein '252, the feed to the hydrogenation zone contains only 10% of heavier components (C₇ or heavier), and thus it is evident that the feed is in the vapor phase, above the critical point.

Furthermore, Stine '252 teaches the use of light olefins (C₇ or lighter) that are circulated, which results in a hydrogenation zone feed that contains extremely high amounts of light olefins. Clearly, the feed to the hydrogenation unit in Stein '252 is significantly different from the feed of the process according to the present invention. Because of the feed employed by Stein '252, **gas phase** (emphasis added) hydrogenation is the **only** (emphasis added) suitable alternative in that process. The Examiner further asserts that the feed in Stine '252 is not necessarily in the vapor

phase because “a feed [that] contains about 10% of heavier components...can still be in liquid phase at certain conditions”. It is respectfully submitted that **under all the conditions taught or suggested in Stein '252, the feed is always in the gas or vapor phase** (emphasis added). The reaction temperature in Stine '252 is always maintained above the dew point, thus resulting in a vapor or gas phase hydrocarbon.

Additionally, Stine '252 is absolutely silent about the use of trickle-bed reactors. The Examiner asserts that although "[t]he Stine reference does not specifically disclose that the feed is in liquid phase...[i]t would have been obvious...to have modified the process of Stine by utilizing a liquid feed for the hydrogenation process because it would be expected that the results would be the same or similar when using a vapor feed or a liquid feed because the state of the feed before entering the reactor is not important...". Applicants respectfully and strongly disagree. Trickle-bed reactors are three-phase reactors with operating principles that differ significantly from the principles of other reactors. The three-phase reaction **necessarily** (emphasis added) occurs between gaseous and liquid reactants. The use of liquid feedstock is not merely an option: it is **essential** (emphasis added) to use liquid feedstock in connection with trickle-bed reactors. In trickle-bed reactors, the liquid phase flows down a fixed catalyst bed and the gas flow flows either co-currently or countercurrently with the liquid flow. The co-current model is more widely used as it doesn't present the risk of flooding and thus larger quantities of liquid can be processed with it. Hydrodynamics in trickle-bed reactors are defined by flow regime, liquid holdup, pressure drop, gas and liquid distribution, and mass and heat transfer. These parameters, especially the gas and liquid flow rates, determine the reactor performance and the outcome of the reaction(s) taking place. Clearly, the reactor disclosed by Stine '252 is

not a trickle-bed reactor and the feed is not in the liquid phase. The Examiner further asserts that “in the figure of Stine, the reactants flow downward through the catalyst beds, so it is clear that these reactors are trickle bed reactors as claimed”. It is respectfully submitted that pressurized gas or vapor phase may flow downward in a reactor, as shown in Stine ‘252. **However, this does not mean that the reactor is a trickle-bed reactor** (emphasis added). It is well known in the art that an **essential feature** (emphasis added) of trickle-bed reactors is that **liquid** (emphasis added) flows downwards on the catalyst surface. **Gas reactants may flow downwards or upwards in trickle-bed reactors** (emphasis added).

In a trickle-bed reactor where both gas and liquid flow downwards, other flow modes are possible in addition to trickling flow. Examples include spray flow (liquid drops), foaming flow (liquid and gas form foam), pulsing flow (liquid and gas as alternating pulses) and liquid slugs (liquid flows as clusters). Reaction conditions like pressure and temperature, in addition to the flow rate of gas and liquid, have an effect on the flow mode. Under these other flow modes the catalyst is not constantly completely wetted. Under the reaction conditions in the trickle-bed reactor of the present application, the temperature and the pressure ensure that both liquid phase and gas phase are present. Furthermore, these conditions result in a trickling flow, thus ensuring constant wetting of the catalyst. It is respectfully submitted that all of the reactants in Stine ‘252 which flow downwards are in the gas phase (as acknowledged by the Examiner), and, thus, it is clear that Stine ‘252 does not disclose a trickle bed reactor.

Furthermore, the process according to Stine '252 requires high amounts of fresh hydrogen due to a lack of hydrogen circulation. If hydrogen circulation is used, special arrangements are needed in order to carry out the circulation. The hydrogenation conditions of Stine '252 require

expensive special materials because of potential corrosion and result in a highly expensive process. In stark contrast, when a trickle-bed reactor is used in the process according to the present invention, no circulation of hydrogen is needed. Furthermore, hydrogen losses are unsubstantial, and the catalyst is always covered by liquid, which results in significantly better local control of temperature. Investment costs are significantly smaller when compared with gas phase reactors and no special materials are needed in the equipment of the instant invention. In addition, the process configuration of the present invention comprises gas separation integrated to the reactor, which can not be found in Stine '252.

Stine '252 also fails to teach or suggest the use of a feed-stock comprising 80-97 wt % of C₈ olefins, 3-20 wt % of C₁₂ olefins, 0.1-7 wt % of C₉, C₁₀, C₁₁ and heavier C₁₂ olefins and optionally minor amounts of lighter C₆-C₇ olefins. The Examiner acknowledges this deficiency, but asserts that "it would have been obvious...to have modified the process of the Stine (sic) by using a feed containing the olefin types and amounts...because such a feed falls within the class of feeds disclosed by Stine and therefore would be expected to be effectively treated in the process of Stine." Applicants respectfully disagree. Stein '252 discloses a feed-stock comprising 28.5 mol% isobutene and 69% mol normal butane. Small amounts of propane, butene and isopentane may be added as well (see Example in column 15). There is no suggestion or motivation in the disclosure of Stein '252 or in the knowledge generally available in the art to utilize the specific olefins of the instant invention in the specific concentrations described, absent hindsight gleaned from Applicants' disclosure.

Additionally, Stine '252 fails to disclose the use of a feed-stock comprising 1-1000 wt-ppm of sulphur compounds. The Examiner acknowledges this deficiency but relies on the

teachings of Lyman '823 to overcome the same. Lyman '823 is directed to a process for the production of motor fuels from the polymerization of normally gaseous olefins. Lyman '823 discloses two alternatives for the hydrogenation of the polymer product. When the polymer liquid is low in sulphur, a conventional low-pressure liquid phase process employing a sulphur-sensitive catalyst (nickel) is suitable. However, large quantities of sulphur in the polymer render the catalyst inactive. On the other hand, with higher sulphur contents in the polymer, gas phase hydrogenation is suggested in the presence of a molybdenum-containing catalyst. It is evident that Lyman '823 teaches different processes in the presence of different catalysts. Furthermore, the catalysts are not (emphasis added) noble metal catalysts as disclosed in the claims of the present application. Clearly, Stine '252 in view of Lyman '823 does not teach or suggest, alone or in combination, the process according to the present invention, which provides a high quality and sulphur-free product in an efficient and economic way.

Furthermore, assuming *arguendo* that Lyman '823 cured the deficiencies of Stine '252 (a point which Applicants do not concede), it is noted that references cannot be arbitrarily combined. There must be some reason why one of ordinary skill in the art would be motivated to make the proposed combination of the primary and secondary references. *In re Nomiya*, 184 USPQ 607 (CCPA 1975). One skilled in the art would have not been motivated to modify the teachings of Stine '252 or to combine the teachings of Stine '252 with those of Lyman '823. One skilled in the art would not have been motivated to utilize the specific olefins of the present invention, at specific concentrations, specifically in a trickle-bed reactors at the specific conditions of the present invention, absent hindsight gleaned from Applicants' disclosure.

Clearly, Stine '252 and Lyman '823 fail to teach or suggest all the limitations of the instant invention and, thus, fail to render the same obvious.

Consequently, it is respectfully submitted that this application is in condition for allowance. A Notice of Allowance is earnestly solicited.

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact Andrew D. Meikle, Reg. No. 32,868 at the telephone number of the undersigned below, to conduct an interview in an effort to expedite prosecution in connection with the present application.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37.C.F.R. §§1.16 or 1.14; particularly, extension of time fees.

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Respectfully submitted,

By _____

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